

# Electric Energy Systems

## Course Introduction & An Overview of Power Systems

Smith College, EGR 325  
January 29, 2008

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## Objectives for an Energy System?

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- What do we do with energy? Why do we use electricity?
- What are the objectives of an energy system?
  - How do we get the desired energy services at low cost?
  - What do we want from the power system?
- What are the strengths and weaknesses of electric energy systems today?

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## Decisions for Energy Systems?

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- How would you like to see energy systems evolve over your lifetime and into the future?
  - How do we choose which technologies are used to generate electricity? Who chooses?
  - How do we plan and who plans for system expansion?
  - Is all future load to be met with same level of reliability?
- Who balances environment with reliability with cost issues?
- What role do/should engineers and scientists play in energy policy development?

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## Course Information

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- Course webpage
  - <http://www.science.smith.edu/~jcardell/Courses/EGR325/>
  - Check homework for this week
- Reading
  - Text and other articles
- Homework – *this Friday!*
  - Some standard problem sets
    - Standard format for engineering problem sets
  - Computer modeling exercises
  - Project
- Exams
- Prerequisites: EGR 220

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## Course Topics

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- The electric power *system*
  - Understanding a complex system
- Energy resources
  - Fossil fuels
  - Renewable resources
- Energy conversion technologies
  - Conventional (fossil fuels)
  - Renewable energy technologies

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## Course Topics

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- Environmental issues
  - Pollutant emissions
  - Global warming, acid rain, ground ozone
- Demand-side topics
  - Energy efficiency
  - Conservation
- The transmission system
  - A giant AC circuit

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## Course Topics

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- Power system planning and operations
  - Computer models
- Motor lab equipment
- Biomass in Honduras – semester project
  - Farmers' collaborative
  - With SI and Oxfam
  - Rural electrification and increased agricultural sales

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## Class Overview

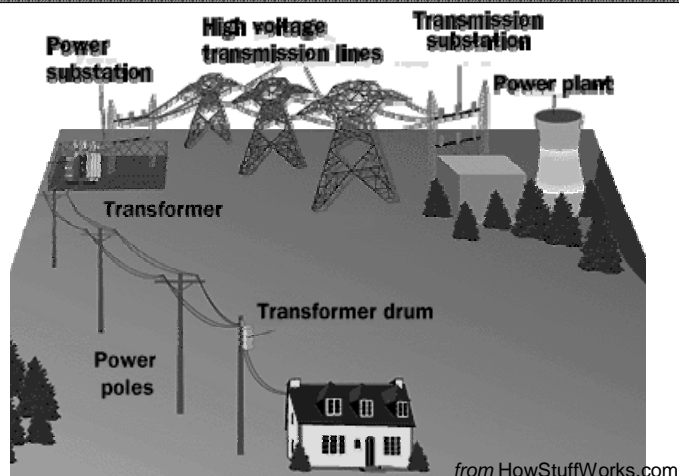
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- Goals of energy systems
- Course topics
  - Components of electric power systems
- Concept map

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## Power System Components

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## Major Elements of Power Systems

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- Generation
- Transmission
- Distribution

## Major Elements of Power Systems

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- Generation, Power Plants
  - Fossil fuel powered
  - Renewable energy
- Transformers
- Transmission Lines
- Distribution Lines
- System Control & Operation
- Customers & Conservation
- Protection Devices

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## Control Center

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## Evolving Industry Structure

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- A private industry, yet...
- Historically – Legal monopolies
  - Government regulation of
    - Rates, Siting, Environmental issues
    - Obligation to serve all people
- Recently
  - Generation is competitive
  - Many new companies
- What is government's role?

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## Engineers and Policy

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- Industry organization affects
  - The type of technologies companies are willing to purchase and install
  - The areas that have R&D funding
- Who controls and operates the power system
  - Engineers?
  - Economists?
  - MBAs?
  - People with a background in all areas!?

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## Future Power Systems

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- Lower polluting power plants
- Newer generating technologies
  - Renewable energy technologies
  - Fuel cells
- Distributed generation
- Power electronics
  - Interconnecting generating technologies
  - Transmission system technologies
- Automation and control

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## Course Topics

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- The electric power *system* – complex system
- Energy resources
- Energy conversion technologies
- Environmental topics
- Demand-side opportunities
- The transmission system
- Power system planning and operations
- Motor lab equipment
- Biomass in Honduras – rural electrification

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## Concept Map

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- Course Concept Map

<http://www.science.smith.edu/~jcardell/Courses/EGR325/ConceptMap.pdf>

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## Thursday Class

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- Fossil fuel resources (chapter 3), plus
- A lot of reading...
- Skim!! ... with the objective of bringing thoughts, questions and brainstorm to class
- Topics
  - Federal energy policy – why have one?
  - Ethanol – is it a good idea?

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## Summary

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People need energy services, for just about every aspect of life

– Reliable, cheap, safe, clean...

- Electricity is reliable, cheap, safe
  - Clean?
- Semester – an introduction to planning and operating a power system

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